

Alloneuron trinervium (Melastomataceae: Cyphostyleae), a new species from Colombia

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Abstract: *Alloneuron trinervium*, a new species of Melastomataceae known only from the type locality in Antioquia Department, northwestern Colombia, is described and illustrated. This new species is the only one in *Alloneuron* with three basal veins, a venation pattern that is intermediate between semi-craspedodromous (found in all other members of the genus) and acrodromous (predominant in the rest of the family). *Alloneuron trinervium* is further distinguished by the paniculate inflorescences with 4-merous, pedicellate flowers arranged in monochasial cymes bearing 3(–5) flowers along the filiform paracladia. This is the first species in the genus found in an inter-Andean valley and not in the eastern slope of the Andes.

Keywords: Antioquia, endemism, taxonomy, venation pattern.

Resumen: Se describe e ilustra *Alloneuron trinervium*, una nueva especie de Melastomataceae conocida sólo de su localidad tipo en el departamento de Antioquia, noroeste de Colombia. Esta nueva especie es la única del género con tres venas basales, un patrón de venación intermedio entre semicraspedódroma (el cual se encuentran en las restantes especies del género) y acródroma (predominante en el resto de la familia). *Alloneuron trinervium*, se distingue adicionalmente por las inflorescencias paniculadas con flores 4-meras, pediceladas, dispuestas en cimas monocasiales de 3(–5) flores en paracladios filiformes. Esta es la primera especie del género conocida de un valle inter-Andino y no de la vertiente oriental del los Andes.

The tribe Cyphostyleae (Melastomataceae) was initially described by Gleason (1929) to include *Allomaieta* Gleason and *Cyphostyla* Gleason, genera that presented an unusual character combination for the family: haplostemonous flowers (stamens number equal to the petals) with inferior ovaries that developed into capsular fruits. Renner (1993) placed these genera and *Alloneuron* Pilg., which shared those same characters in the tribe Miconieae due to their inferior ovary and anthers without pedoconnective. However, *Allomaieta* and *Cyphostyla* have been shown to form a distinct clade not closely related to Miconieae, and Cyphostyleae has been resurrected as a distinct

tribe (Michelangeli et al., 2011). After the segregation of *Wurdastom* B. Walln. from *Alloneuron* (Wallnöfer, 1996), synonymization of *Cyphostyla* under *Allomaieta* (Lozano & Becerra-de-Lozano, 1999), and the description of a new genus (Michelangeli et al., 2014), Cyphostyleae currently includes four genera *Allomaieta*, *Alloneuron*, *Quipuanthus* Michelang. & C. Ulloa, and *Wurdastom*. The tribe contains 24 species with this new taxon (Mendoza-Cifuentes, 2020; Michelangeli et al., 2020; Murillo & David, 2021) and it is found in the Andes and inter Andean valleys up to 2700 m (Michelangeli et al., 2011; Michelangeli et al.,

2014; Mendoza-Cifuentes, 2020). The majority of the species in Cyphostyleae have small ranges and are poorly represented in herbaria, making it one of the least understood groups of neotropical Melastomataceae (Michelangeli et al., 2011; Michelangeli et al., 2014; Mendoza-Cifuentes, 2020).

Within Cyphostyleae, *Alloneuron* is characterized by the combination of stellate trichomes throughout its vegetative organs and hypanthia, 4–5-merous flowers, the calyx closed in bud forming a calyptra, a straight style, sub-spherical capsules, and tuberculate seeds (Michelangeli et al., 2011). Most notably, however, is that all of the currently known species present pinnate or craspedodromous venation, giving its member species an appearance that is markedly different from most other members of the family with acrodromous venation (Wallnöfer, 1996, 1999; Michelangeli et al., 2011).

To date, five species of *Alloneuron* are known distributed throughout the Amazon foothills of the Andes, from southern Colombia to Peru (Wallnöfer, 1996, 1999; Michelangeli & Ulloa Ulloa, 2016; Michelangeli et al., 2020). Wallnöfer (1996, 1999) studied the morphology of the genus in detail and proposed two sections based on the distance between the flowers along the inflorescence: *A. sect. Alloneuron* and *A. sect. Meiandra* (Markgr.) B. Walln. The most recently described species, *A. glomeratum* C. Ulloa & Michelang., shares characters of both sections and was not assigned to either one (Michelangeli & Ulloa Ulloa, 2016).

As part of the 18th ColombiaBio program expedition to the Municipality of Anorí in the Department of Antioquia, in northwestern Colombia, an unknown Melastomataceae was collected. Based on floral morphology this new species clearly belongs to the Cyphostyleae, but its generic placement was more problematic due to its venation. Here we describe this collection as a new species, discuss the rationale to place it in *Alloneuron*, and provide comparisons with other members of the genus.

Materials and methods

Types and specimens of putative relatives were evaluated in person at COAH, COL, CORD, F, MO, NY, US (Thiers, 2020) or through high resolution photographs from the Plants JSTOR

Global Plants (<https://plants.jstor.org/>). Vegetative structures were observed and measured from herbarium materials. Flower measurements were taken after rehydration in 70% ethanol. Description and diagnosis follows other taxa in the genus (Wallnöfer, 1996, 1999; Michelangeli & Ulloa Ulloa, 2016) and Beentje (2016). Leaf venation characters follow Ellis et al. (2019).

Observations of leaf venations patterns were made from herbarium samples that were then cleared following Ellis et al. (2019). The leaves were soaked in the 5% solution of NaOH for 15 days, then washed for 30 s. with NaClO (3%), with subsequent washes in distilled water. The cleared leaves were then stained with Safranin O (Ruzin, 1999) and photographed with a digital camera (Olimpus E-620).

Leaf and seed samples were mounted on aluminum stubs with double-sided conductive adhesive and sputter-coated with gold-palladium for 5 min at 15 mvolts in a Denton Vacuum Desk V apparatus. These were then photographed in a Scanning Electron Microscopy (SEM) Hitachi SU-3500 using the SE detector.

The distribution map was generated with QGIS version 3.10 (QGIS Development Team, 2020). Conservation status was evaluated following the IUCN Red List categories and criteria (IUCN, 2012) and guidelines (IUCN Standards and Petitions Committee, 2019).

Results

Alloneuron trinervium J.S.Murillo, Michelang. & H.David, **sp. nov.**—Type: Colombia, Antioquia: Municipio de Anorí, vereda Solano, sector: entrando al campamento Iracales por la quebrada del Oro, ruta hacia la casa de Obed. 07.34358°N, 075.12503°W, 700 m, 22 June 2018, (bud, fr), *H. David et al. 6433* (holotype: HUA [mounted on two sheets] accessions 220628 [!] and 220629 [!]; isotype: NY [!]). (Figs. 1–2, 3B–D, 4.)

Diagnosis: *Alloneuron trinervium* can be distinguished from all other species in the genus by the leaves with 3 basal veins in a venation pattern that is intermediate between semicraspedodromous and acrodromous, with the tertiary veins looping between the secondaries and the entire to obscurely sinuate margin (vs. pinnate in the remaining species in the genus with the tertiary veins reaching the margin); inflorescences filiform with long paracladia and monochasial cymes bearing 3 flowers, these 4-merous and pedicellate. *Alloneuron trinervium* is similar to *A. glomeratum* but differs by its paracladia with 5–85-merous flowers arranged in pseudo-glomerules.

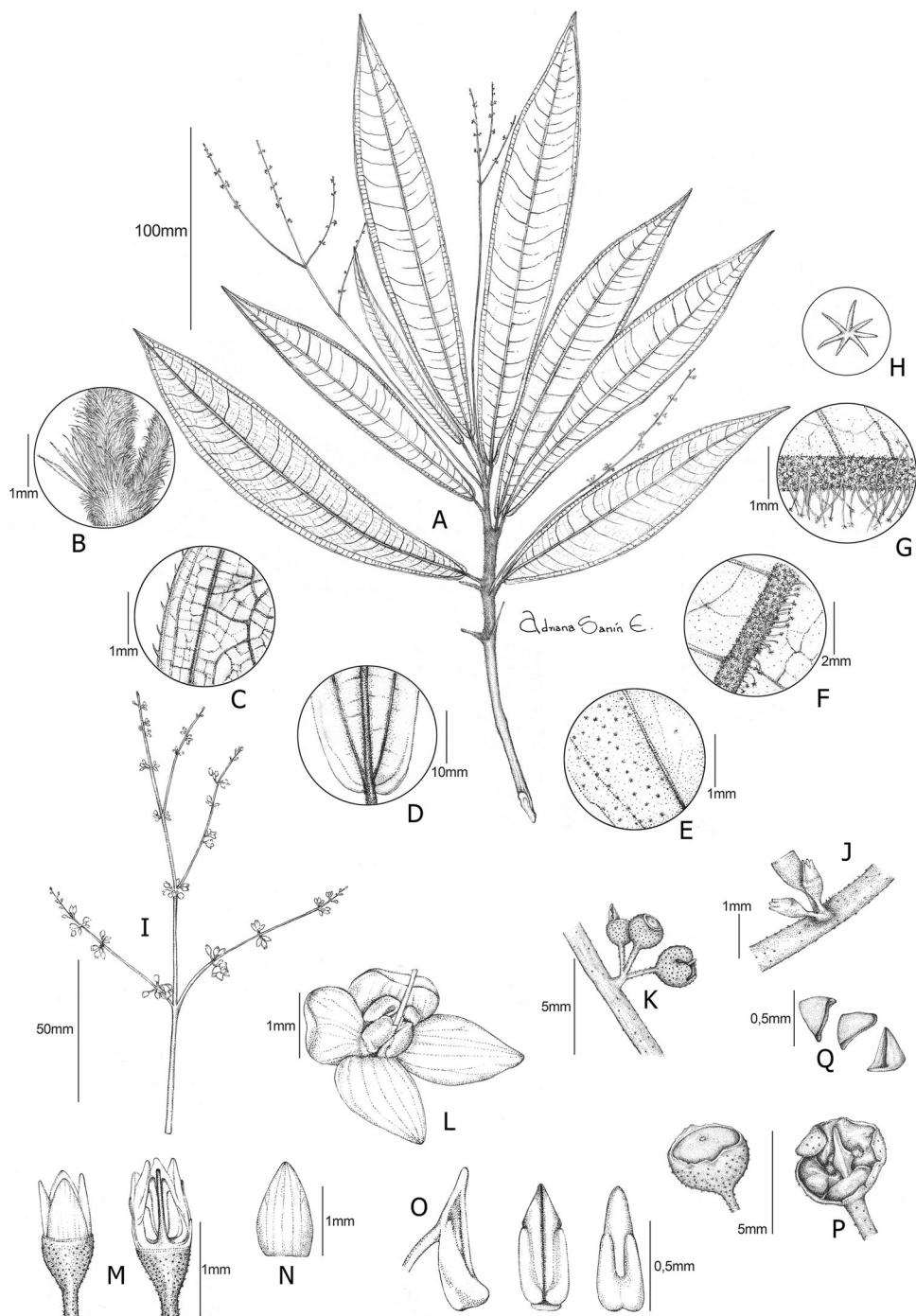


FIG. 1. *Alloneuron trinervium*. A. Flowering branch. B. Detail of young stem and node. C. Detail of leaf margin, abaxial surface. D. Detail of leaf base, abaxial surface. E. Detail of adaxial surface and mid-vein. F. Detail of leaf abaxial surface showing secondary vein. G. Detail of leaf abaxial surface showing primary vein. H. Detail of stellate trichome from leaf abaxial surface. I. Inflorescence. J. Detail of individual monocasial cyme in bud. K. Detail of individual monocasial cyme in fruit. L. Flower, top view. M. Flower bud in lateral view, and with a petal removed (right). N. Petal, adaxial surface. O. Anther, in lateral, dorsal, and ventral view. P. Fruits before and after dehiscence. Q. Seeds. (Drawn from David et al. 6433 by Adriana Sanin.)

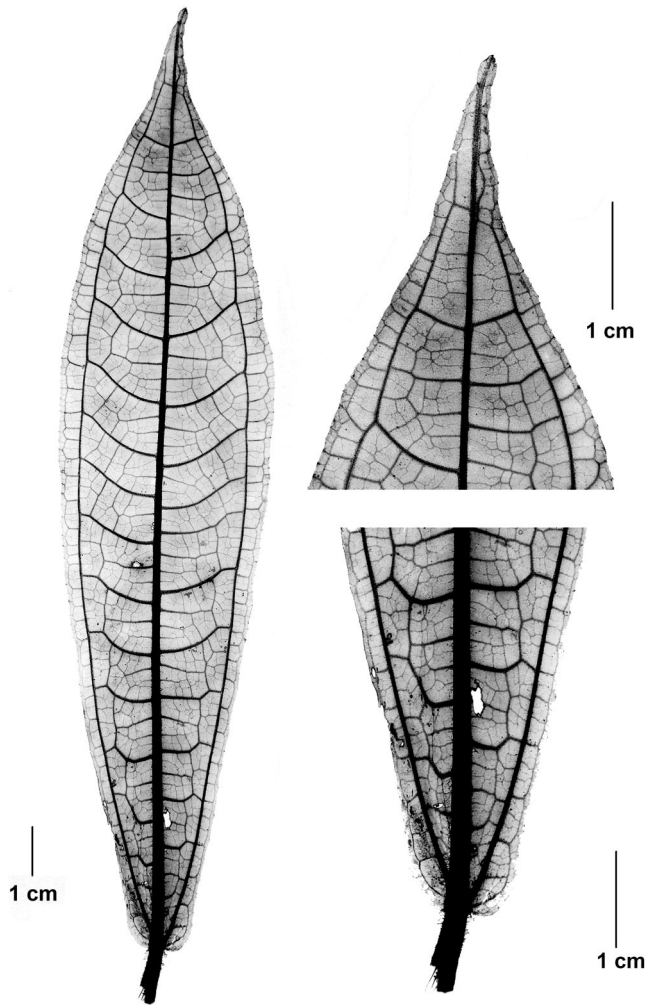


FIG. 2. Cleared leaves of *Alloneuron trinervium*, with the entire leaf and details of apex and base (David et al. 6433).

Subshrub, ca. 70 cm tall. Stems terete, young branches with internodes 1–5 cm long, 2.5–5 mm diameter, densely pubescent when young, glabrescent later on, the indument with a mix of trichomes including stipitate stellate, barbellate, ciliform (these straight to slightly curved, the apex acute, truncate or cupuliform, 0.5–2 mm long), and stellate (ca. 40 μ m wide); nodes with a dense line of flattened trichomes, 0.5–3 mm long, the apex acute. Leaves opposite, isophyllous; petioles terete, 5–15 mm long, 0.6–1.9 mm diam., with the same indument as the young stems; blades 11–22 $\times$ 1.5–4 cm, membranaceous, elliptic-lanceolate, oblanceolate, base obscurely subcordate, apex acute and mucronate, the margin entire to sinuous, with ciliate trichomes, these straight or curved

apically, 0.2–0.5 mm long, less dense towards the middle of the lamina. Venation imperfectly acrodromous to semi-craspedodromous, with a pair of secondary veins arising from the base and arching towards the apex; tertiary veins running between primary and secondary ca. 20 pairs per leaf, percurrent, slightly curved and sigmoid, spaced 1.5–12.4 mm apart; tertiary veins between secondaries and the margin bifurcated with the exterior portion reaching the secondaries or the margin and the interior looping towards the next tertiary; primary, secondary and tertiary veins raised on the abaxial surface and impressed in the adaxial surface, primary vein in the abaxial surface densely pubescent with a mix of trichomes as in the stem, similarly in the secondary

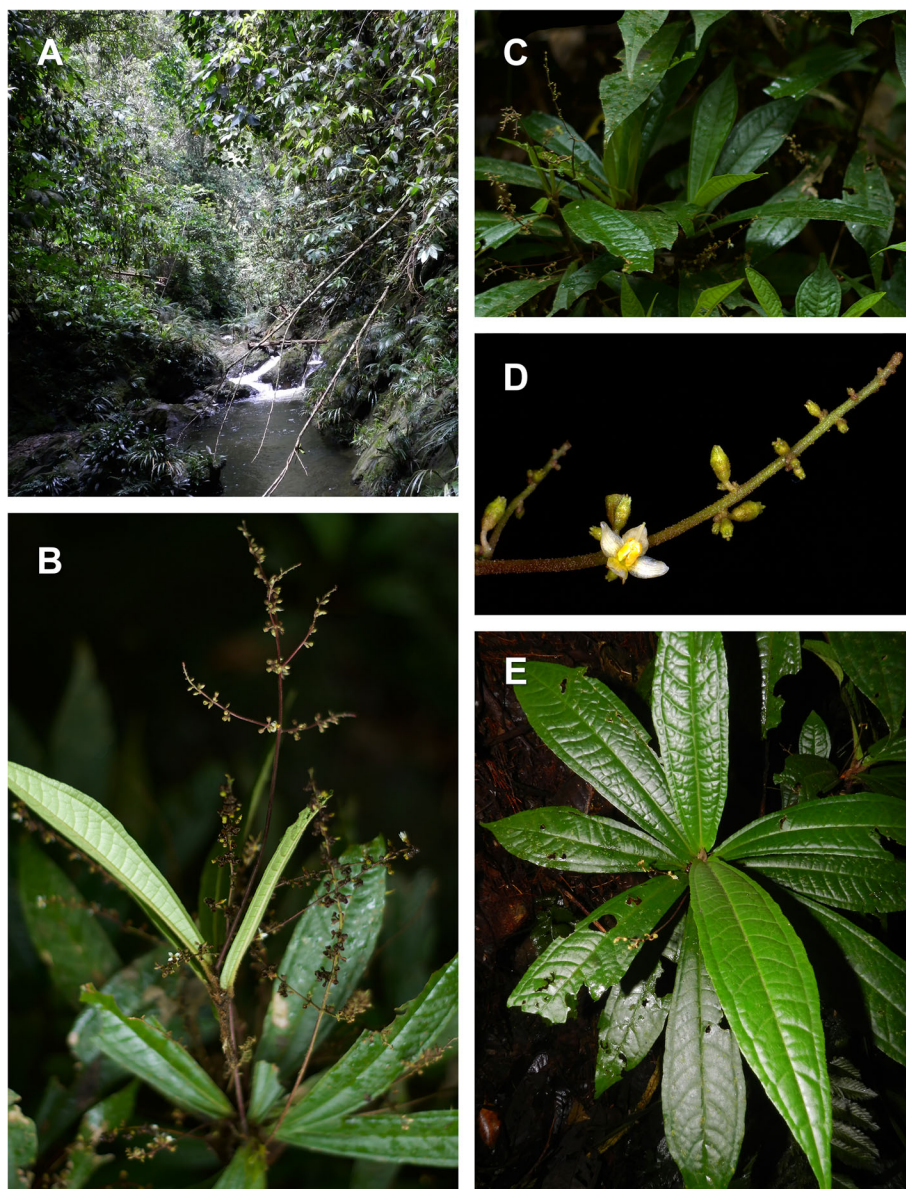


FIG. 3. *Alloneuron trinervium* in the field. **A.** Habitat along small stream. **B.** Flowering branch. **C.** Habit. **D.** Detail of inflorescence with bud and an open flower. **E.** Leaves, adaxial surface.

veins but less dense; higher order veins and leaf abaxial surface sparsely pubescent, principally covered by stellate trichomes ca. 40 μm wide. Inflorescences 10–35 cm long, terminal, paniculate, with filiform paracladia, glabrescent or with lax indument of trichomes, these stellate and ciliform with acute apex; paracladia with sub-opposite monochasial cymes bearing 3(–5) flowers. Bracteoles not seen. Flowers 4-merous;

pedicels 0.5–1.5 mm long, ca. 0.2 mm diam (1–3 mm long in fruit). Hypanthium 0.5–1 mm long, densely pubescent, the trichomes stellate. Calyx calyptrate in bud, ca. 0.8 mm long in bud, with 4 apical lobes, apparently irregularly rupturing at anthesis. Petals ca. 1.5 mm long (preanthetic), triangular, the apex acute in bud and acute-convex at anthesis, glabrous, white. Stamens 4, oppositisealous; filaments ca. 0.5 mm long,

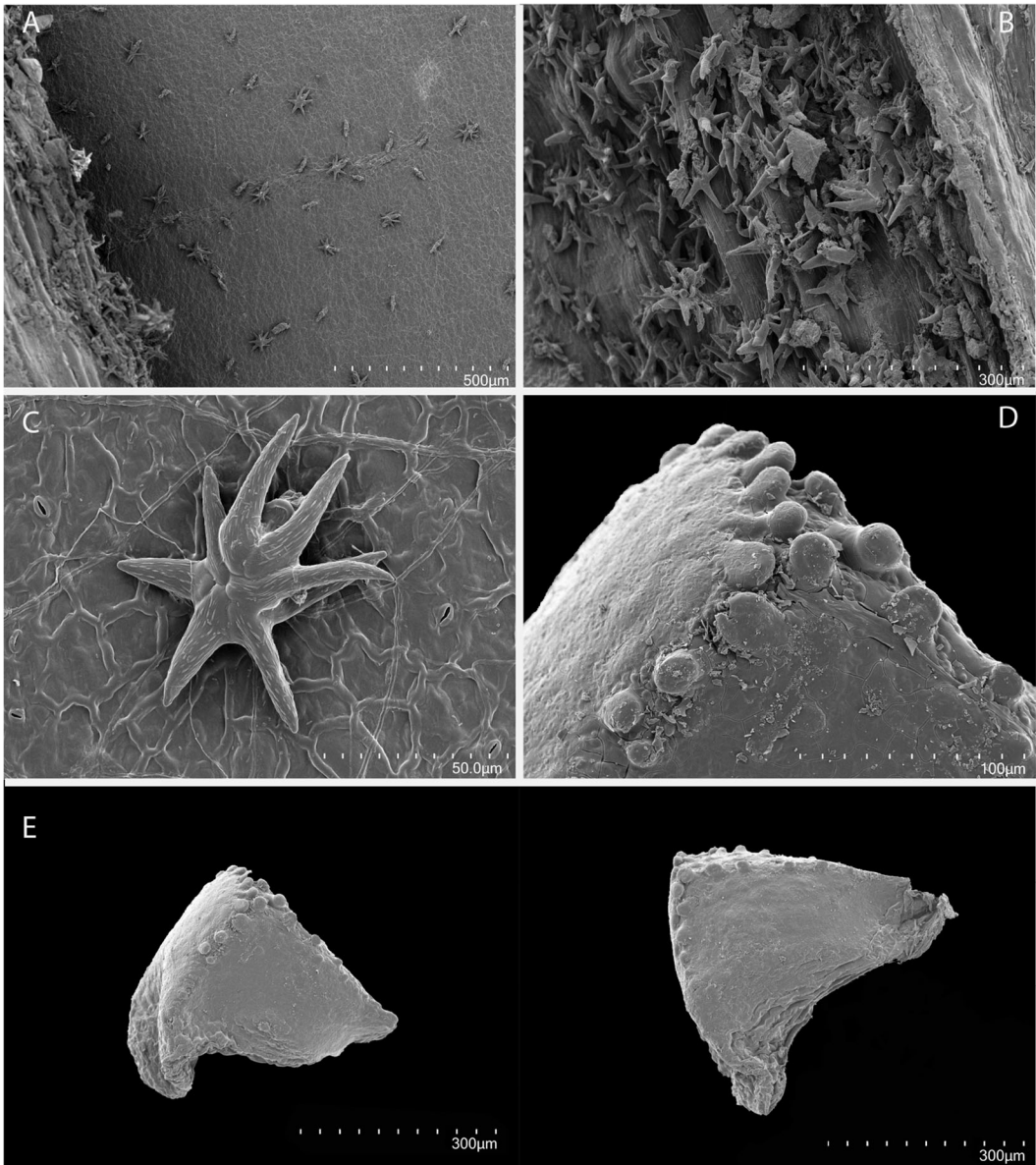


FIG. 4. Scanning electron micrographs of *Alloneuron trinervium*. A. Abaxial surface and midvein of the leaf. B. Detail of the indumentum of the midvein in the abaxial leaf surface. C. Stellate trichome on the abaxial leaf surface. D. Detail of the anti-raphal portion of the seed. E. Two seeds in anti-raphal and lateral view. (All photos from the holotype).

glabrous; anthers oblong, ca. 0.5 mm long, opening by a terminal to slightly dorsal pore, yellow; pedoconnective absent, but the connective prolonged dorso-basally into a deflexed, triangular tooth, 0.3 mm long. Ovary inferior, 3-locular; style ca. 1.5 mm long; straight, exerted beyond the stamens, glabrous, stigma punctate, minutely glandular. Fruit a capsule, globose, 2 mm long,

1.5 mm diam., with irregular dehiscence from the apex, older fruits with the central axis and placenta persistent and star-shaped. Seeds ca. 150 per fruit, pyramidal, $0.25\text{--}0.35 \times 0.3\text{--}0.5$ mm, the surface flat, but the edges tuberculate in the anti-raphal portion.

Distribution and habitat.—*Alloneuron trinervium* is only known from the Anori River valley in

Antioquia, Colombia (Fig. 5), in a primary forest of the Andean piedmont at an elevation of ca. 700 m. The known individuals grow in groups near a shaded stream (Fig. 3A). This region has been poorly collected to date, primarily due to the armed conflict in Colombia, which has indirectly favored the conservation of small areas with forest cover (Price, 2003). *Alloneuron trinervium* is the only species in the genus to occur in an inter-Andean valley, part of the Magdalena River basin, whereas all other *Alloneuron* are found in the eastern slopes of the Andes within the Amazon River basin (Wallnöfer, 1996, 1999; Michelangeli & Ulloa Ulloa, 2016). However, other species of

Cyphostyleae, mainly *Allomaieta*, do occur in the area (Lozano & Becerra-de-Lozano, 1999). It should be noted that all species of *Alloneuron* have relatively small ranges, inhabit areas prone to deforestation, and have small populations; these challenges, coupled with the limited available data, mean we have an imperfect understanding of this species' distribution.

Conservation status.—*Alloneuron trinervium* is known only from the type collection, with an estimated area of occupancy (AOO) smaller than 10 km². The locality is not within any conservation unit and recently it has been under deforestation pressure to convert the area to

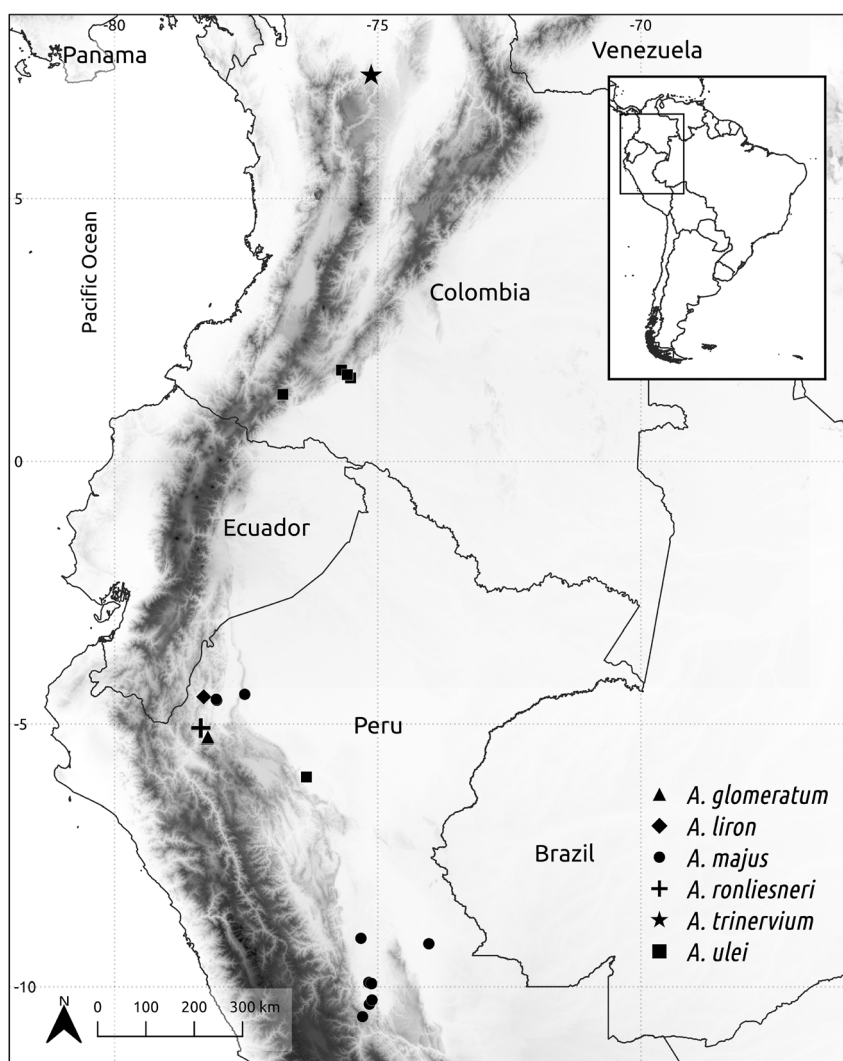


FIG. 5. Distributions of *Alloneuron* species.

agricultural and mining activities. Based on the fact that this species only grows in primary forests and near streams, and the type of habitat is under constant pressure, we recommend that it is assigned a status of “Critically Endangered (CR)” under the following IUCN Red List criteria: B2ab(ii,iii) (IUCN, 2012; IUCN Standards and Petitions Committee, 2019).

Etymology.—The epithet calls attention to the three prominent veins at the leaf base, giving it a pseudo-acrodromous appearance, a character that distinguishes it from all other species in the genus.

The new species described here undoubtedly belongs to the tribe Cyphostyleae based on the haplostemonous flowers with inferior ovaries that develop into dry semi-spherical fruits (Michelangeli et al., 2011). It clearly does not belong in *Quipuanthus*, which has an herbaceous habit, glandular trichomes, recurved styles, and tubular fruits that open by valves (Michelangeli et al., 2014). *Alloneuron trinervium* differs from *Allomaieta* because the latter has a shrubby habit, usually bi-colored and large petals, recurved styles, and seeds with a smooth testa (Michelangeli et al., 2011). At first glance the more problematic assignment is between *Wurdastom* and *Alloneuron* which share the presence of straight styles and semi-spherical fruits, but are most easily separated by the acrodromous leaves in *Wurdastom* versus pinnate leaves in *Alloneuron* (Wallnöfer, 1996; Michelangeli et al., 2011; Mendoza-Cifuentes, 2020). *Alloneuron trinervium* presents a venation pattern that is imperfectly acrodromous to semi-craspedodromous (Fig. 3); thus, while it does not fit the pinnate pattern of the other species of

Alloneuron, it also does not fit within the typical acrodromal pattern of *Wurdastom*. Moreover, this new species has several other characters that support its placement within *Alloneuron* rather than *Wurdastom*: suffruticose habit (vs. shrubs to small trees), presence of stellate trichomes (vs. absent), inflorescence with monochasial units (vs. thyrsoid), and seeds with a tuberculate testa (vs. seeds with a smooth testa) (Wallnöfer, 1996; Michelangeli et al., 2011; Mendoza-Cifuentes, 2020).

Within *Alloneuron*, *A. trinervium* is, as noted above, most easily distinguished by its leaf venation (Fig. 2). However, it is morphologically closest to *A. ulei* Pilg. and *A. glomeratum* C. Ulloa & Michelang., both with pinnate and semi-craspedodromous venation. Table 1 summarizes the main differences and similarities between these species, most notable inflorescence architecture: *A. glomeratum* has flowers arranged in pseudo-glomerules with 5–8 flowers along the ciliform paracladia, whereas *A. trinervium* and *A. ulei* differ in the number of paracladia, flower merosity, and the separation between flowers. Additionally, *A. trinervium* is clearly distinguishable from the remaining species in the genus: *A. majus* (Markgr.) Markgr. ex J.F. Macbr. has larger leaves, flowers, and fruits, *A. liron* B.Walln. has paniculate inflorescences, and *A. ronliesneri* B.Walln. has pandurate and petate leaves up to 7 cm long.

With close to 23,000 species of vascular plants, Colombia is considered a megadiverse country (Bernal et al., 2016), with a high proportion of endemism, especially in the Andes (Myers et al., 2000). However, the country has

TABLE 1. MAIN DIFFERENCES BETWEEN *ALLONEURON TRINERVIUM* AND RELATED SPECIES.

Character	<i>Alloneuron ulei</i>	<i>Alloneuron glomeratum</i>	<i>Alloneuron trinervium</i>
Leaf size	5.5–22.5 × 1.8–6 cm	13.4–23 × 4–6.5 cm	11–22 × 1.5–4 cm
Leaf venation	pinnate, semi-craspedodromous	pinnate, semi-craspedodromous	imperfectly acrodromous to semi-craspedodromous
Leaf margin	erose	denticulate, sinuos	entire to slightly sinuos
Inflorescence	filiform	paniculate	paniculate, with first-order filiform paracladia
Inflorescence units	solitary flowers	pseudo-glomerulate, with 5–8 flowers	monochasial cymes with 3(–5) flowers
Spacing between flowers	2–7 mm	< 1 mm	< 1 mm
Pedicel length	1 mm	< 0.5 mm	0.5–3 mm
Flower merosity	5	5	4

lost over 70% of its forests and all ecosystems present some degree of fragmentation (Cavalier & Etter, 1995). This is exacerbated by the fact that more than two thirds of the population live in the Andes, accelerating the loss of forests to agriculture and urbanization (Etter & van Wyngaarden, 2000). The armed conflict of the past several decades in Colombia has had a determining role on our knowledge and conservation of natural habitats (Alvarez, 2003): the armed conflict reduced habitat degradation in some areas while accelerating it others; however, it has made it difficult to fully access and document biodiversity in several regions (Alvarez, 2003). This situation is exemplified by our discovery and description of this new species that is clearly recognizable as unique, but has been collected only once due to the difficulties in accessing the biodiversity of this area. Moreover, this location has yielded at least one other new species of Melastomataceae (Murillo & David, 2021), underscoring the need for further exploration and urgency to prioritize its unique flora in future management and conservation plans.

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